

WHAT IS CLAIMED IS:

1. A mass filter array comprising:

a first ion selection chamber having an ion inlet lying in an inlet plane and an ion outlet lying in an outlet plane, the first ion selection chamber further having a first plurality of electrodes disposed between said ion inlet and said ion outlet;

a second ion selection chamber having an ion inlet lying in an inlet plane and an ion outlet lying in an outlet plane, the second ion selection chamber further having a second plurality of electrodes disposed between said ion inlet and said ion outlet, the first and second plurality of electrodes including at least one common electrode shared by both the first and second ion selection chambers;

an RF signal generator connected to said first and second plurality of electrodes to produce a rotating electric field respectively in each of said first and second ion selection chambers.

2. A mass analyzer as claimed in claim 1 wherein either or both of said plurality of electrodes comprise at least one electrode having at least two conductive exterior surfaces separated by a dielectric core.

3. A mass filter array as claimed in claim 1 wherein said first plurality of electrodes and said second plurality of electrodes share at least one common electrode to produce the rotating electric fields.

4. A mass filter array as claimed in claim 1 wherein said rotating electric field in said first ion selection chamber is substantially equal in magnitude to said rotating electric field in said second ion selection chamber.

5. A mass filter array as claimed in claim 4 wherein said rotating electric field in said first ion selection chamber is out of phase from said rotating electric field in said second ion selection chamber.

6. A mass filter array as claimed in claim 1 wherein said first plurality of electrodes comprises:
a first pair of opposed electrodes each electrode having a planar surface;
a second pair of opposed electrodes each having a planar surface, the planar surfaces of said second pair of opposed electrodes being oriented generally perpendicular to the planar surfaces of said first pair of opposed electrodes;
said RF signal generator being connected to the first and second pair of opposed electrodes to generate a first rotating electric field therebetween.

7. A mass filter array as claimed in claim 6 wherein said second plurality of electrodes comprises:

a third pair of opposed electrodes each having a planar surface;

a fourth pair of opposed electrodes each having a planar surface, the planar surfaces of said fourth pair of opposed electrodes being oriented generally perpendicular to the planar surfaces of said third pair of opposed electrodes;

said RF signal generator being connected to said third and fourth pair of opposed electrodes to generate a second rotating electric field therebetween that is out of phase with the first rotating electric field.

8. A mass filter array as claimed in claim 5 wherein said first and second pair of opposed electrodes are formed as conductive plates.

9. A mass filter array as claimed in claim 6 wherein said third and fourth pair of opposed electrodes are in the form of conductive plates.

10. A mass filter array as claimed in claim 7 wherein at least one electrode of either said first or second pair of opposed electrodes is shared with either said third or fourth pair of opposed electrodes.

11. A mass filter array as claimed in claim 7 wherein said RF signal generator includes first and second terminals of opposite polarity, said first and third pair of opposed electrodes being connected to said first terminal and said second and fourth pair of opposed electrodes being connected to said second terminal.

12. A mass filter array as claimed in claim 1 wherein said first plurality of electrodes comprises:

a first pair of opposed electrodes each electrode having a concave electrode surface;
a second pair of opposed electrodes each having a concave electrode surface, the concave electrode surfaces of said second pair of opposed electrodes being angularly displaced with respect to the concave electrode surfaces of said first pair of opposed electrodes by about 90 degrees ;

said RF signal generator being connected to the first and second pair of opposed electrodes to generate a first rotating electric field therebetween.

13. A mass filter array as claimed in claim 12 wherein said second plurality of electrodes comprises:

a third pair of opposed electrodes each having a concave electrode surface;

a fourth pair of opposed electrodes each having a concave electrode surface, the concave electrode surfaces of said fourth pair of opposed electrodes being angularly displaced with respect to the concave electrode surfaces of said third pair of opposed electrodes by about 90 degrees; said RF signal generator being connected to said third and fourth pair of opposed electrodes to generate a second rotating electric field therebetween that is out of phase with said first rotating electric field.

14. A mass filter array as claimed in claim 12 wherein at least one electrode of either said first or second pair of opposed electrodes is shared with either said third or fourth pair of opposed electrodes.

15. A mass filter array as claimed in claim 13 wherein said RF signal generator includes first and second terminals of opposite polarity, said first and third pair of opposed electrodes being connected to said first terminal and said second and fourth pair of opposed electrodes being connected to said second terminal.

16. A mass analyzer comprising:
a mass filter unit having

a plurality of ion selection chambers disposed in parallel with one another, each of the plurality of ion selection chambers respectively having an ion inlet lying in an inlet plane and an ion outlet lying in an outlet plane;

a plurality of electrodes disposed in said plurality of ion selection chambers; at least one RF signal generator connected to said plurality of electrodes to produce a rotating electric field in each of said plurality of ion selection chambers;

a plurality of ion injectors respectively coupled to each of said ion inlets of said plurality of ion selection chambers to inject ions into each of said plurality of ion selection chambers.

17. A mass analyzer as claimed in claim 16 wherein said plurality of electrodes comprise at least one electrode having at least two conductive exterior surfaces separated by a dielectric core.

18. A mass analyzer as claimed in claim 16 wherein the inlets of said plurality of ion selection chambers lie substantially in a single inlet plane.

19. A mass analyzer as claimed in claim 18 wherein the outlets of said plurality of ion selection chambers lie substantially in a single outlet plane.

20. A mass analyzer as claimed in claim 16 wherein the outlets of said plurality of ion selection chambers lie substantially in a single outlet plane.
21. A mass analyzer as claimed in claim 16 wherein adjacent ones of said plurality of ion selection chambers share at least one of said plurality of electrodes for generating the rotating electric field in the respective ion selection chamber.
22. A mass analyzer as claimed in claim 16 wherein at least two of said plurality of ion selection chambers share at least one of said plurality of electrodes for generating the non-rotating, oscillating electric field in the respective ion selection chamber.
23. A mass analyzer as claimed in claim 22 wherein said at least two of said plurality of ion selection chambers are disposed immediately adjacent one another.
24. A mass analyzer as claimed in claim 16 wherein at least two of said plurality of ion selection chambers share at least two of said plurality of electrodes for generating the rotating electric field in the respective ion selection chamber.
25. A mass analyzer as claimed in claim 24 wherein said at least two of said plurality of ion selection chambers are disposed immediately adjacent one another.

26. A mass analyzer as claimed in claim 16 wherein the rotating electric fields in adjacent ones of said plurality of ion selection chambers are substantially equal in magnitude.

27. A mass analyzer as claimed in claim 26 wherein the rotating electric fields in adjacent ones of said plurality of ion selection chambers are out of phase with one another by about 180°.

28. A mass analyzer as claimed in claim 16 wherein the rotating electric fields in adjacent ones of said plurality of ion selection chambers are out of phase with one another by about 180°.

29. A mass filter array as claimed in claim 16 comprising:
a first pair of opposed electrodes disposed in a first ion selection chamber of said plurality of ion selection chambers; and
a second pair of opposed electrodes disposed in said first ion selection chamber, said second pair of opposed electrodes being angularly displaced with respect to the first pair of opposed electrodes.

30. A mass analyzer as claimed in claim 29 and further comprising a second ion selection chamber of said plurality of ion selection chambers disposed immediately adjacent said first ion selection chamber, at least one electrode of either said first or second pair of opposed electrodes being shared with said second ion selection chamber.

31. A mass analyzer as claimed in claim 30 wherein said second ion selection chamber comprises:

a third pair of opposed electrodes;

a fourth pair of opposed electrodes that are angularly displaced with respect to the third pair of opposed electrodes; and

at least one electrode of either said third or fourth pair of opposed electrodes constituting at least one electrode of either said first or second pair of electrodes.

32. A mass analyzer as claimed in claim 30 wherein said RF signal generator includes first and second terminals of opposite polarity, said first and third pairs of opposed electrodes being connected to said first terminal and said second and fourth pairs of opposed electrodes being connected to said second terminal.

33. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer adapted to receive a sample substance

from a liquid chromatography apparatus, said sample substance comprising at least one analyte for ionization.

34. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer adapted to receive a sample substance from an electrophoresis apparatus, said sample substance comprising at least one analyte for ionization.

35. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an electrospray device.

36. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer that is adapted to receive a sample material from a direct insertion probe, said sample material comprising an analyte for ionization.

37. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer that is adapted to receive a sample material from a capillary column, said sample material comprising an analyte for ionization.

38. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer that is adapted to generate ions of an analyte using a matrix-assisted laser desorption/ionization process.

39. A mass analyzer as claimed in claim 16 wherein at least one of said plurality of ion injectors comprises an ionizer that is adapted to generate ions of an analyte using an electrospray process.

40. A mass analyzer as claimed in claim 29 wherein the electrode surfaces of said first and second pair of opposed electrodes are concave.

41. A mass analyzer as claimed in claim 29 wherein the electrode surfaces of said first and second pair of opposed electrodes are planar.

42. A mass analyzer as claimed in claim 30 wherein the electrode surfaces of said first and second pair of opposed electrodes are concave.

43. A mass analyzer as claimed in claim 30 wherein the electrode surfaces of said first and second pair of opposed electrodes are planar.

44. A mass analyzer as claimed in claim 16 and further comprising a plurality of ion detection surfaces proximate respective ion outlets of each of said plurality of ion selection chambers, each of said plurality of ion detection surfaces being positioned to primarily detect ions exiting substantially at a predetermined exit angle with reference to the outlet plane of the respective ion selection chamber to the general exclusion of ions having other exit angles.

45. A mass filter comprising:

a first pair of opposed electrodes, each electrode of said first pair having a concave electrode surface, said concave electrode surfaces of said first pair of opposed electrodes facing one another;

a second pair of opposed electrodes, each electrode of said second pair having a concave electrode surface, said concave electrode surfaces of said second pair of opposed electrodes facing one another and being angularly displaced with respect to said concave electrode surfaces of said first pair of opposed electrodes; and

an RF signal generator having a first terminal connected to said first pair of opposed electrodes and a second terminal connected to said second pair of opposed electrodes to thereby generate a rotating electric field between said concave electrode surfaces.

46. A mass analyzer as claimed in claim 45 wherein at least one electrode of either said first or second pair of opposed electrodes comprises at least two conductive exterior surfaces separated by a dielectric core.

47. A mass analyzer as claimed in claim 45 wherein said concave electrode surfaces of said first pair of opposed electrodes and said concave electrode surfaces of said second pair of opposed electrodes are angularly displaced from one another by about 90 degrees.